

ipdia

“The 3D silicon leader”

March 2012



IPDiA overview

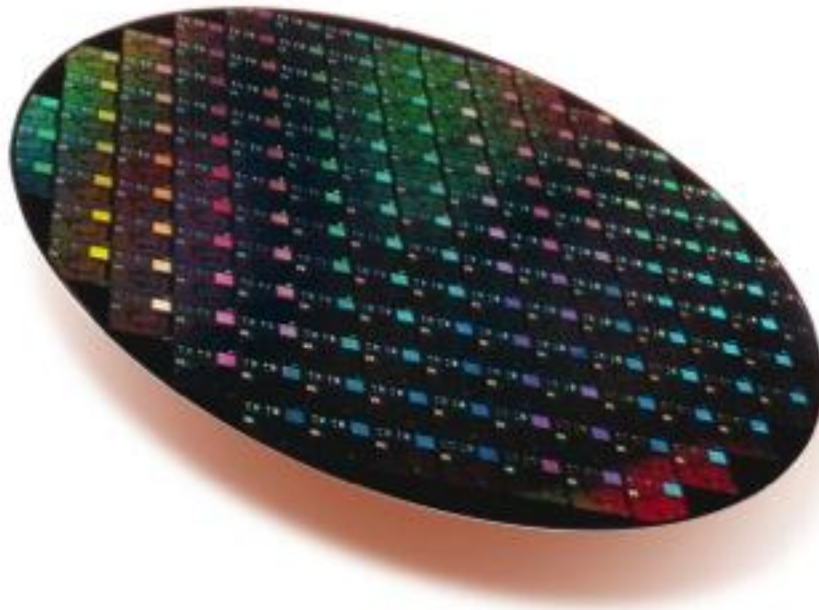
- Company located in Caen, Normandy, France
- Dedicated to manufacturing of integrated passive devices
- Employing 100 people and operating own wafer fab
- Strong R&D team and collaborations with leading institutes



What do we do?

Strategy based on two main axes :

- Submounts for High Brightness LED market
- Integrated Passive Devices (IPD) for Medical, Industrial, Aerospace and Defense

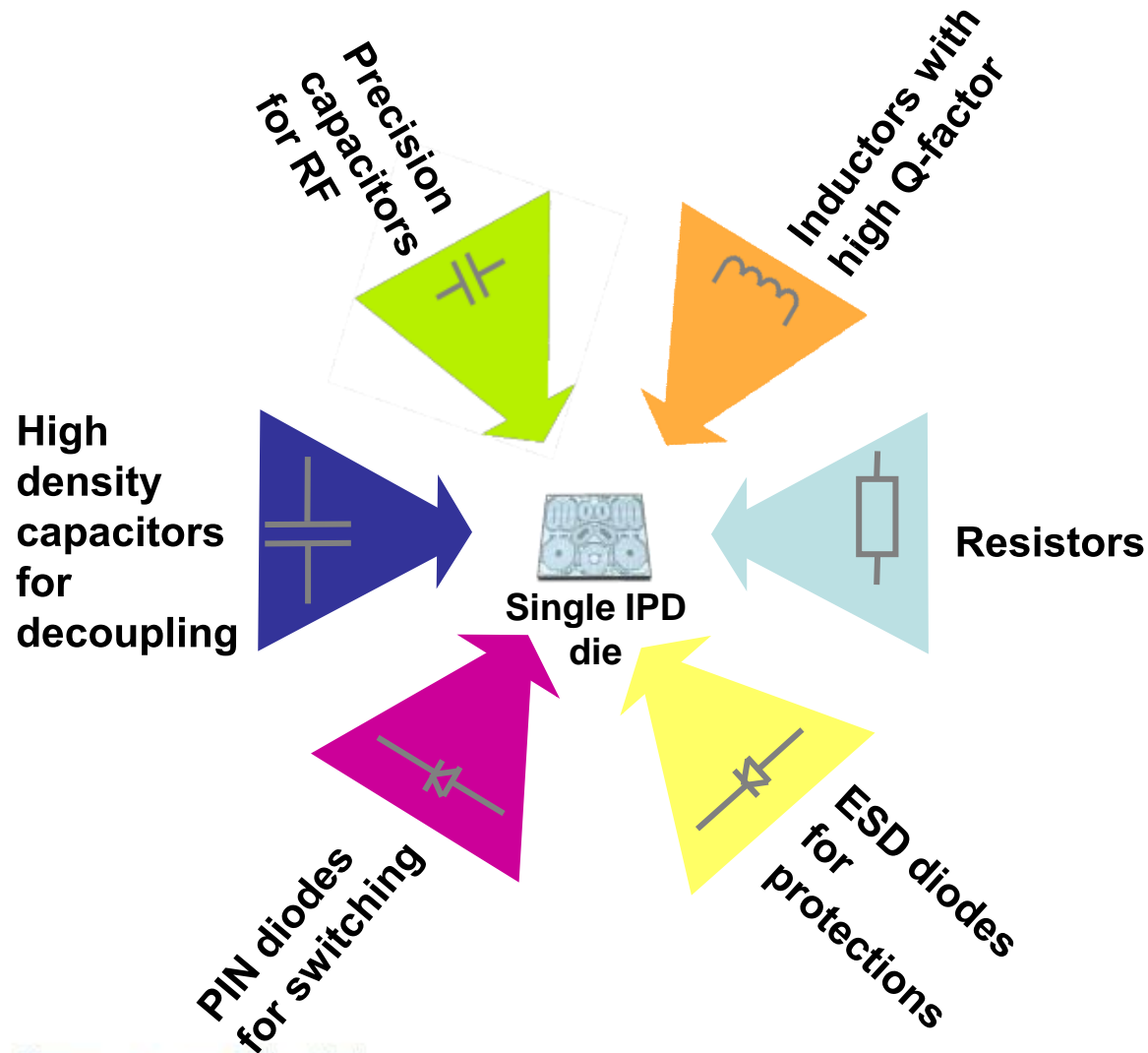


IPD



submount

What is **IPD**? **I**ntegrated **P**assive **D**evice



PICS is IPDiA IPD
Passive
Integrated
Connecting
Substrate

A highly efficient way to integrate several passive components such as resistors, capacitors, inductors, ESD diodes and PIN diodes in a single. All of them, thanks to our technology very flexible.

IPDiA's quality certifications

The IPDiA manufacturing center is certified:

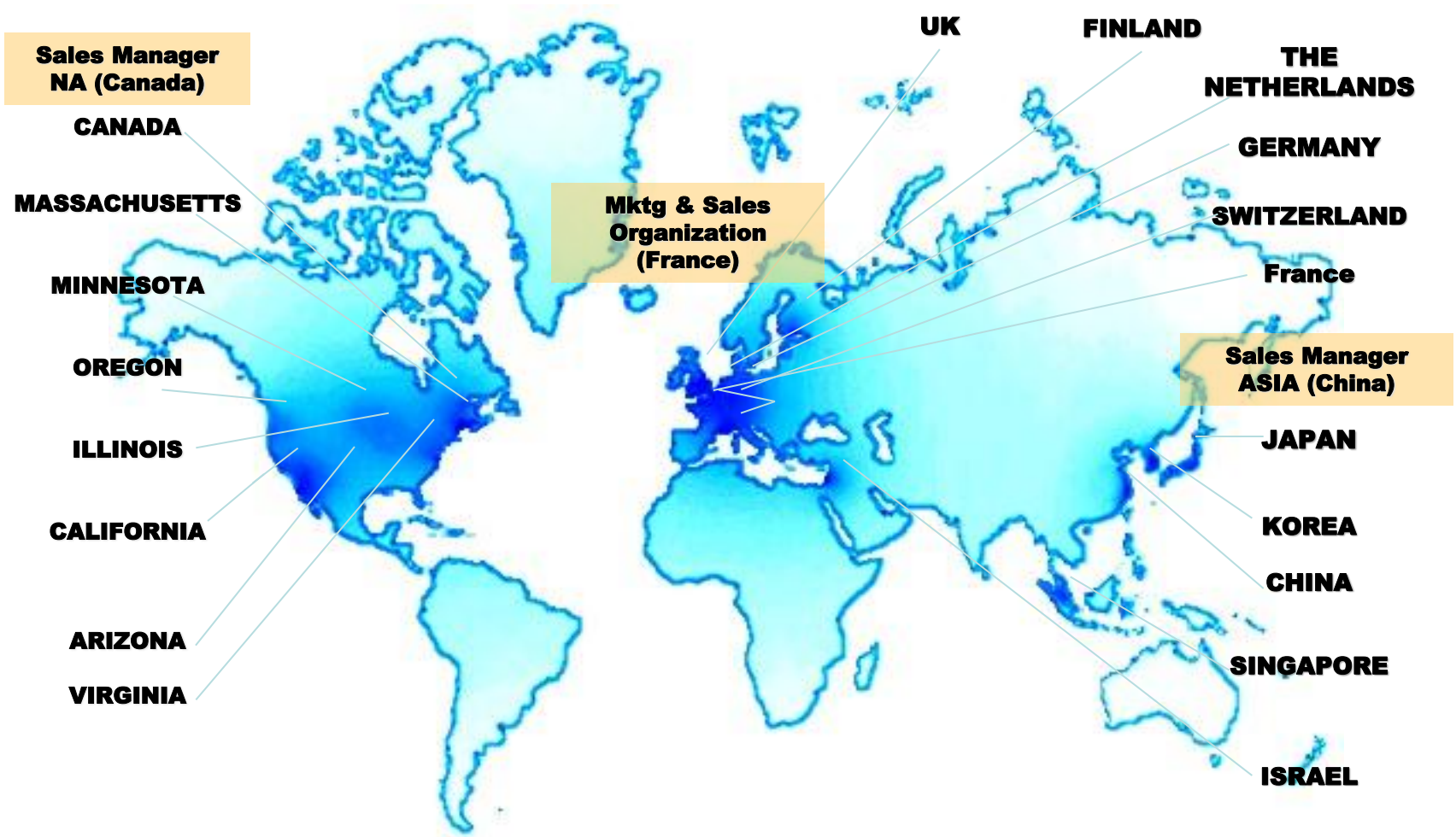
- ISO-9001
- ISO-14001
- ISO-TS16949 (Automotive)
- ISO-13485 (Medical)
- OHSAS-18001

IPDiA is RoHS compliant



IPDIA has implemented a global approach from the start

**Sales Manager
Nth Europe
(Germany)**



IPDiA value proposition : Technology that enables

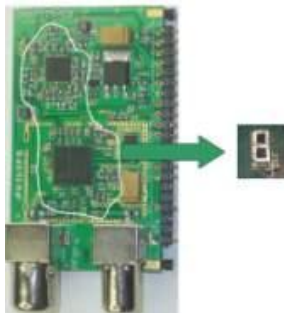
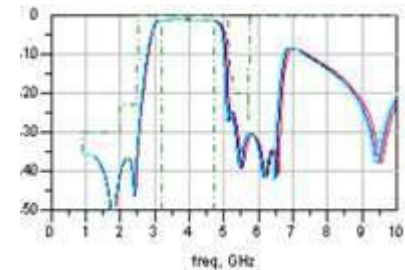
- **Miniaturization**

- Size of electronic devices can be reduced by a factor of 10
- Thickness as low as 100 μm



- **Performance**

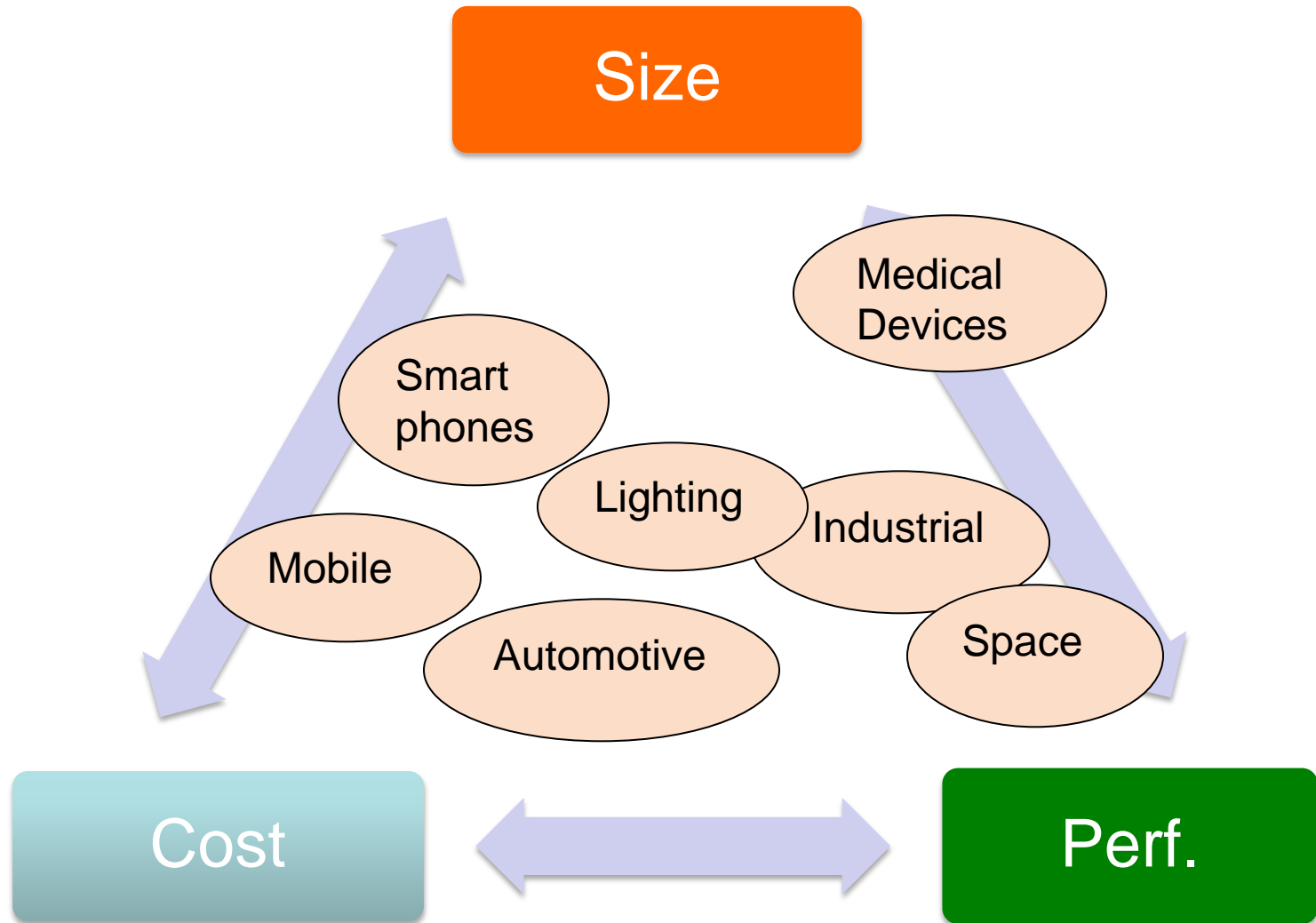
- High stability (temp, voltage, ageing...)
- High reliability (no cracking unlike Ceramic)
- Low consumption (battery lifetime)



- **Reduced Cost**

- BOM level
- Simpler manufacturing

Why IPD's : main drivers



A person wearing a blue full-body protective suit, hood, and mask is working inside a large, complex industrial machine. The machine has multiple levels with perforated metal walls and various mechanical components, including rollers and pipes. The person is holding a small object, possibly a vial or component, and is focused on their task. The background shows more of the industrial environment with white cabinets and a metal platform.

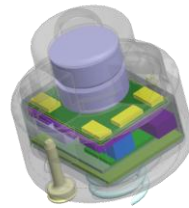
**In the Medical Market
PASSIVES are NOT at all
commodities**

Miniaturization: Example of medical devices

Cardiac Rythm Management



Today : 10 cm³



2013 : 3 cm³



2015 : 1 cm³

*More than 40 mm² of
PICS inside*

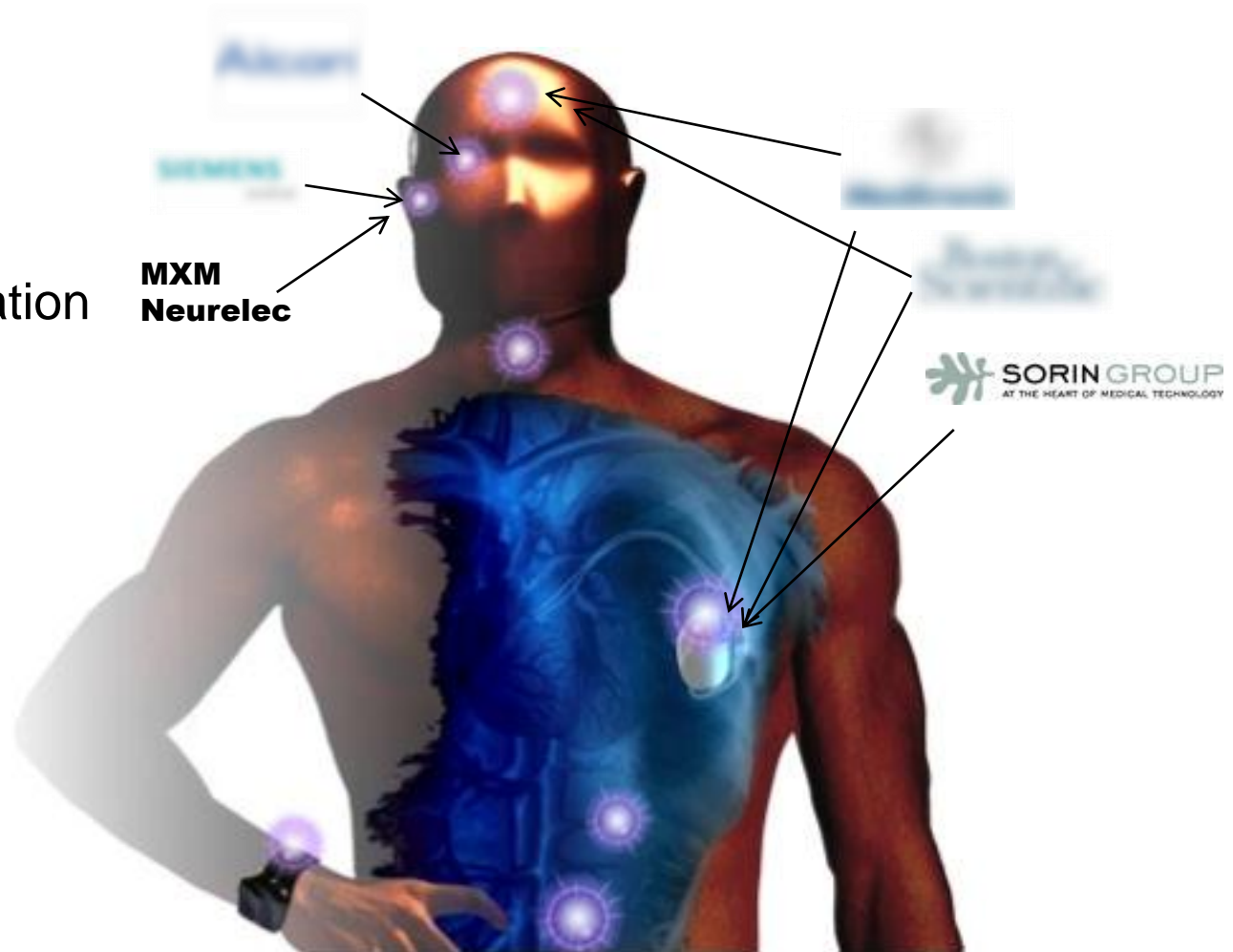
**IP protected
(all generations)**

Implantable devices

Existing programs :

Prototypes

Products in qualification



ipdia **Product offer**



- **3D Silicon Submounts**

- Submount for HB LED Packaging + ESD Protection
- TVS (transient voltage suppressor) for HB LED



- **3D Silicon RF**

- A range a standard products such as filter, balun, coupler...
- Customized component network (Application Specific Integrated Passives) for RF applications.

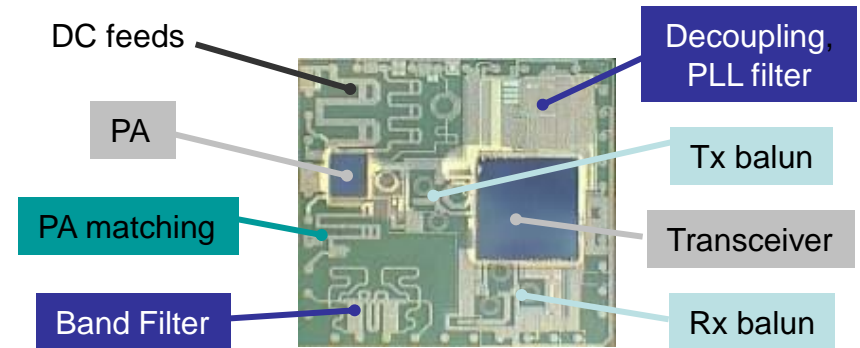
- **3D Silicon Capacitors**

- A range a standard products
 - High stability for “demanding application”
 - Low Profile for ”height constraint application “
 - Wire bonding for near decoupling in IC packaging
- Customized component network ASIP (Application Specific Integrated Passives) for advanced decoupling applications.



Some products with Silicon Passive components

- Silicon passive as **Low profile 1 μ F capacitor** in a SiP



- Silicon Passive as **network component**
40 SMDs integrated in a single Silicon die

- Silicon Passive as **packaging platform** as well as passive network

Several billions of products over the world, with our “3D silicon passive inside”



Wireless

SHARP



E-metering



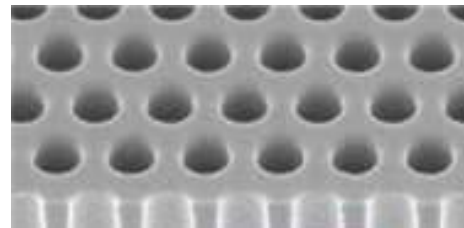
High Brightness LED protection



Medical Devices



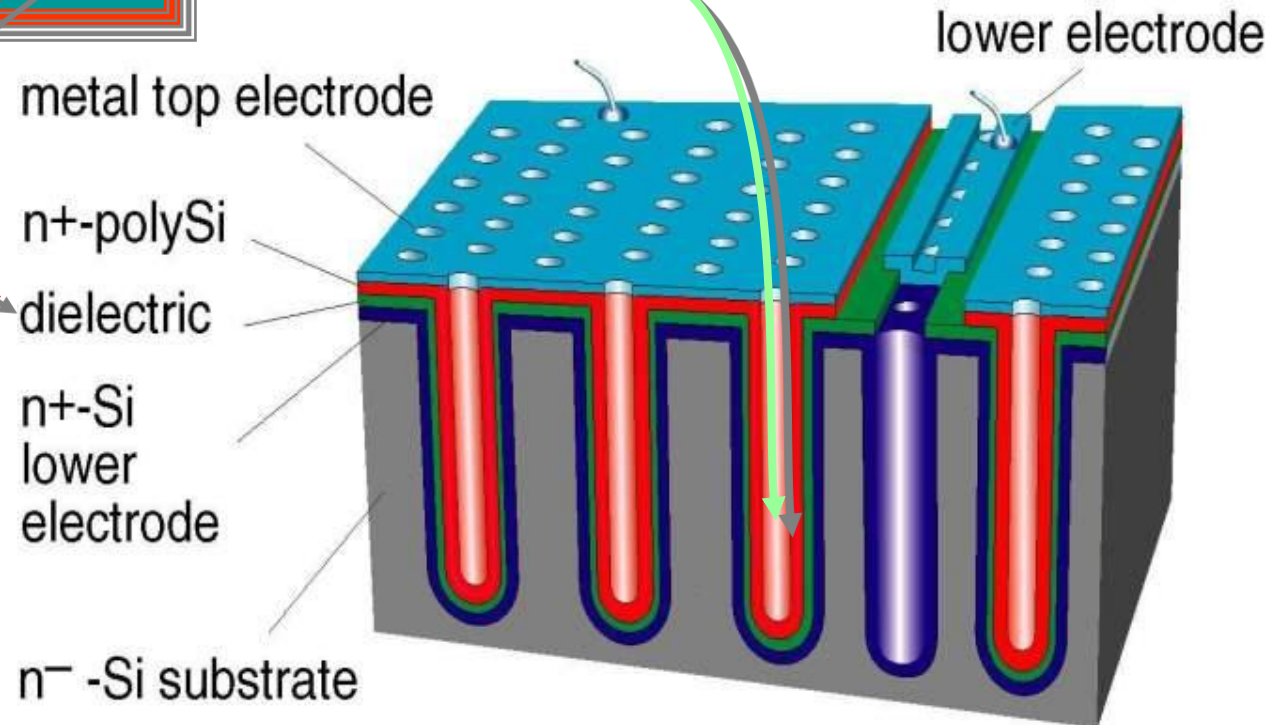
IPDIA's technology



The *world record* of capacitance density in silicon and in mass production

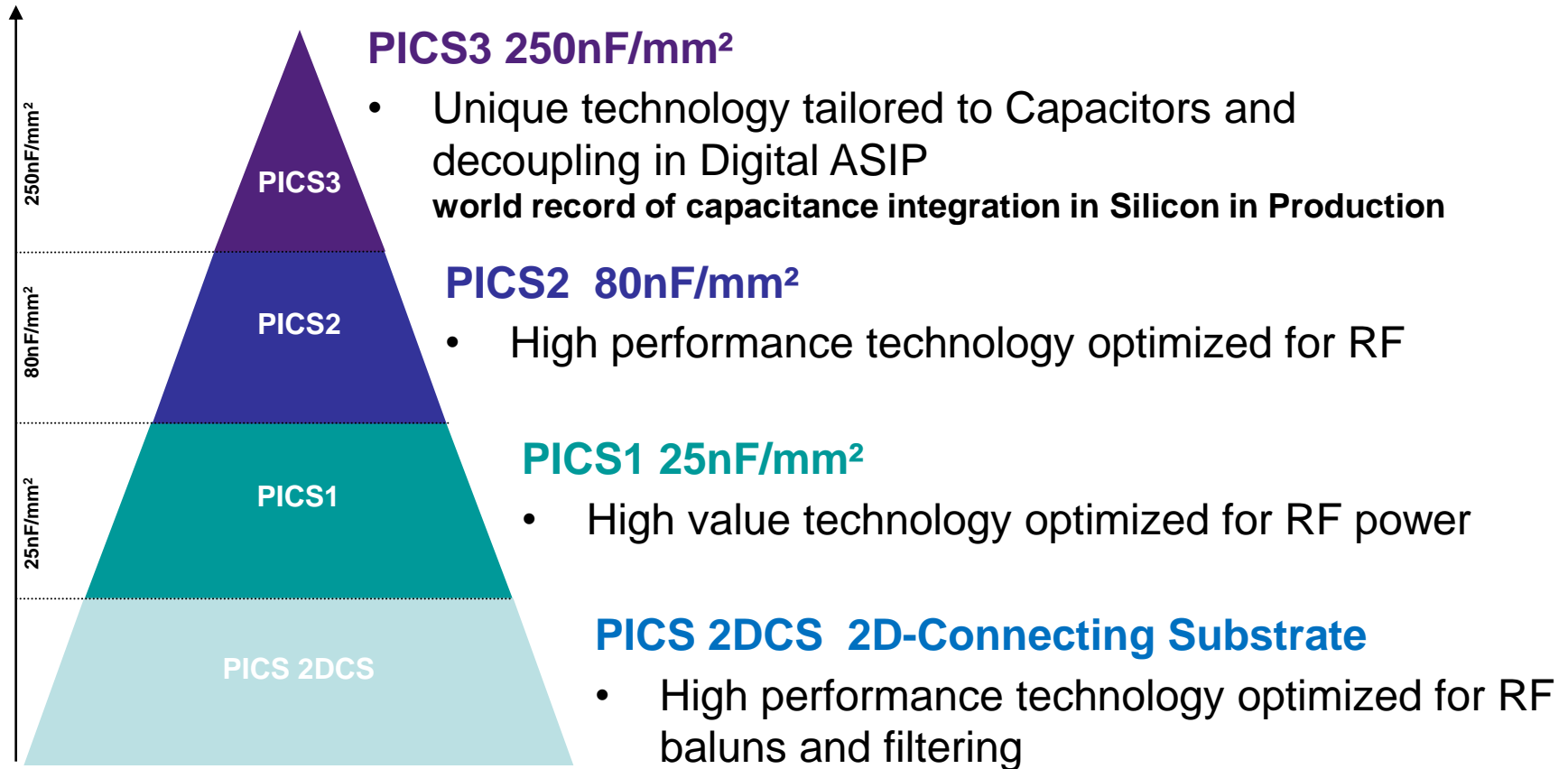
250nF/mm² in production
500 nF/mm² demonstrated

$$C = \frac{\epsilon_0 \epsilon_s \cdot S}{e}$$



Technology offer

- All our products are based on optimized combinations of our 3D Silicon capacitors with additional passive components



3D silicon passive devices with outstanding performances

Capacitors

- Superior temperature stability (<20ppm)
 - Technology characterized to +200°C
- Very low leakage current (<40nA)
- Superior DC voltage stability (<0.1%/V)
 - No capacitance change over voltage variation.
- Very low ESR < 40mOhm

Zener Diodes

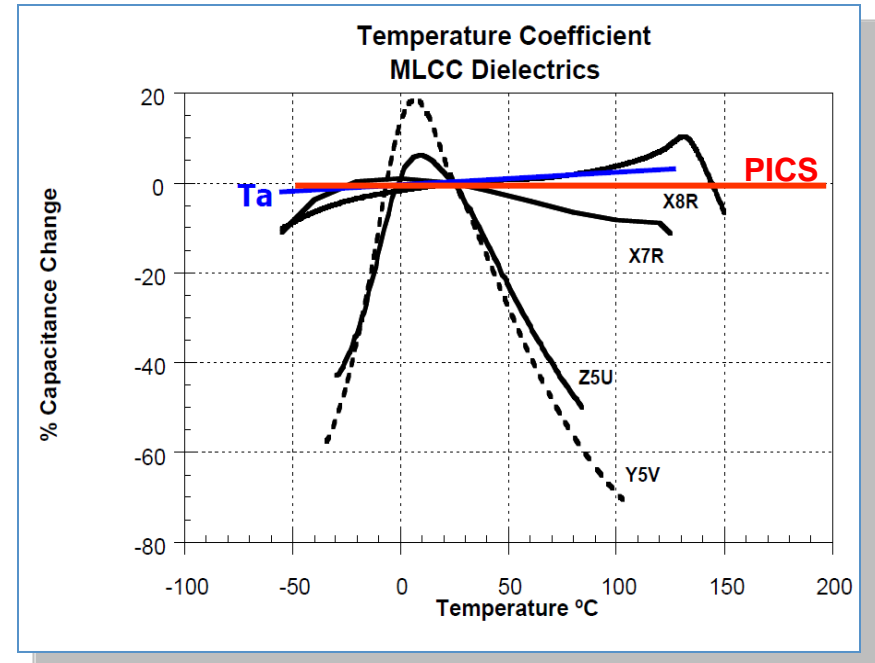
- BV>10V and ESD Capability 15KV Air discharge (IEC 6100-4-2, level4)

Resistors

- Excellent matching (better than 0.5%)

Coils

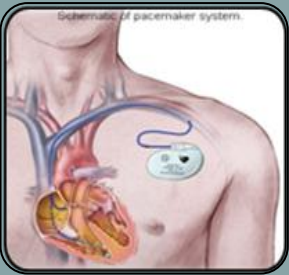
- Superior Q-factor (> 80)
- Self-res. freq. > 45GHz



3D silicon passive technology
allows the complete integration of:

- ° excellent RF filtering
- ° full RF-digital cross-talk cancellation
- ° excellent DC decoupling filtering

High Stability and High Temp Capacitors



High Stability Silicon Capacitor : Very Low derating rate, ageing close to 0%, Low ESR & ESL ,

- *Medical Devices*
- *Medical Equipment*
- *Automotive equipment ...etc.*

High Stability and high temp Silicon Capacitor

Dedicated to applications requiring optimum **Stability** and **Reliability** in term of Temperature, Voltage, Ageing from **-55 to 300°C**

HSSC capacitor is suitable to Industries devices such as:

1.HIGH RELIABILITY Applications

- ✓ Defense
- ✓ Space

2.MEDICAL

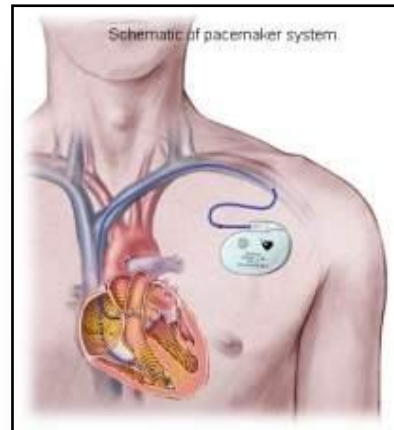
- ✓ *Implants and stimulators*
- ✓ *Medical Equipment*

3.AUTOMOTIVE

- ✓ *Motor control Modules*
- ✓ *Sensors*

➤ Key Benefits: The Lowest Derating Rate (<1%)

- Ageing rate: 0.001% per decade
- Temperature: < $\pm 0.5\%$
- Voltage: 0.1% / Volts
- Longer battery lifetime
- ESR down to 90m Ω
- ESL down to 100pH



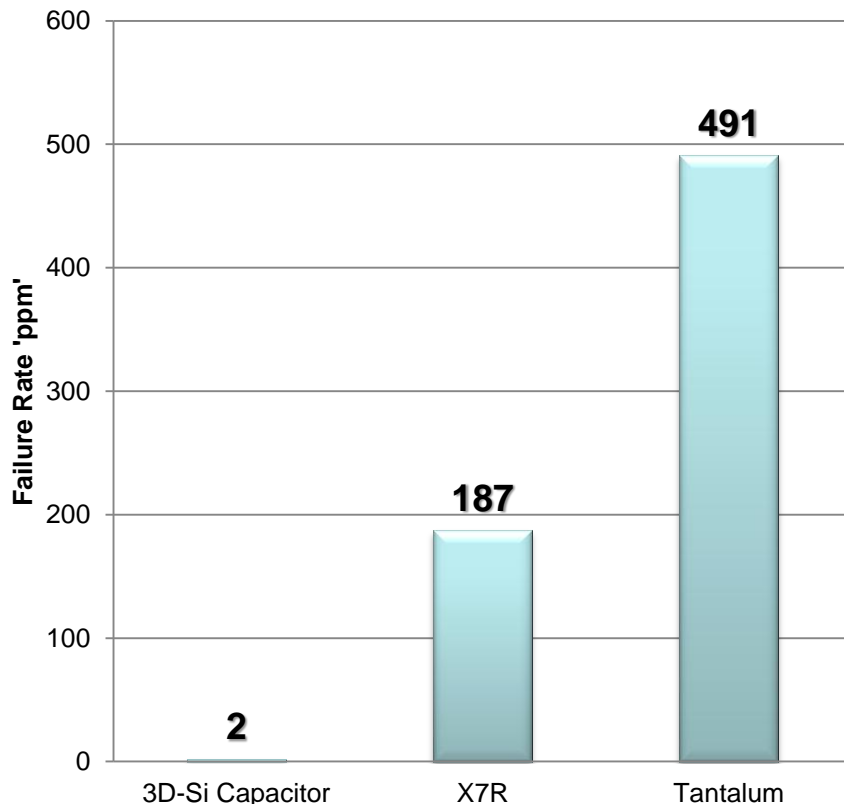
Pacemaker



Electronic components in automotive

Failure Predictions of Tantalum, Ceramic 'X7R' and 3D-Si based Capacitors

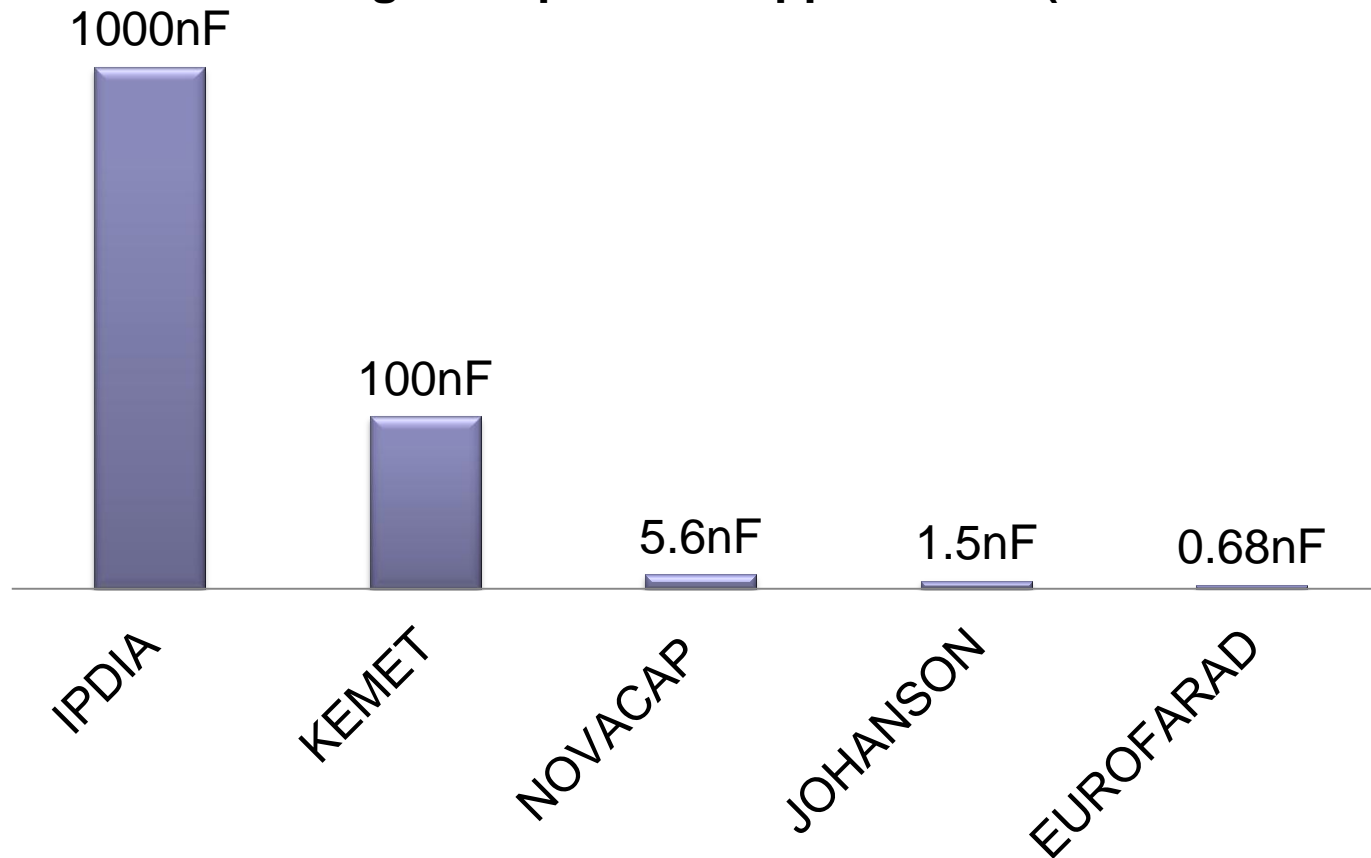
Projected Failure Rate in 10 Years



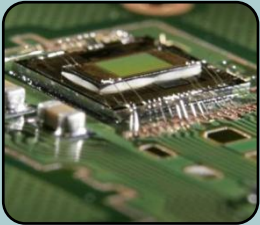
- ✓ Used at **85°C** and 50% of the Rating voltage the **Failure Rate** of a **Silicon Capacitor** is **Insignificant** (Only **2 Units failed on a Million** after **10 Years** operation time)
- ✓ This **very low Failure Rate** confirms the **Excellent Reliability** of **3D Silicon Capacitors**

High Temperature Silicon Capacitor (HTSC)

1206 EIA Case size Capacitors comparison
High Temperature Applications (-55°C to 300°C)



Low Profile Capacitors



Low Profile Silicon Capacitor (LPSC) *Thickness down to 100 μ m*

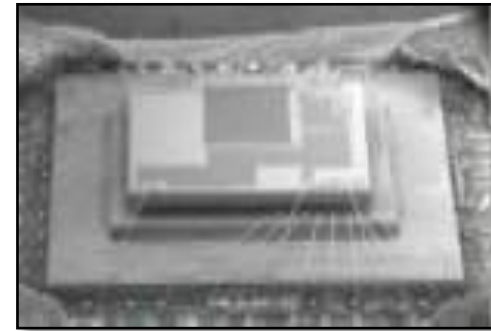
- *System in Package (SiP), ...etc.*
- *IC modules*
- *ASICS*
- *Embedded Electronics (cellphones, smartphones, ...etc)*

Low Profile Silicon Capacitor (LPSC)

➤ **Dedicated** to applications where **Space** plays a key role like embedded capacitors, System in Package 'SiP', IC modules, ASICS

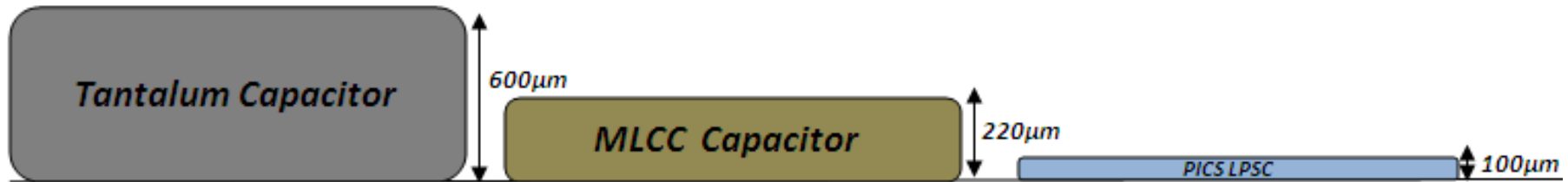
➤ Key Benefits

- **Unique** capacitor of **1 μ F** available in **100 μ m Thickness**
- ESR down to 90m Ω
- ESL down to 100pH
- Same **Out of Standard** performances that HSSC capacitor

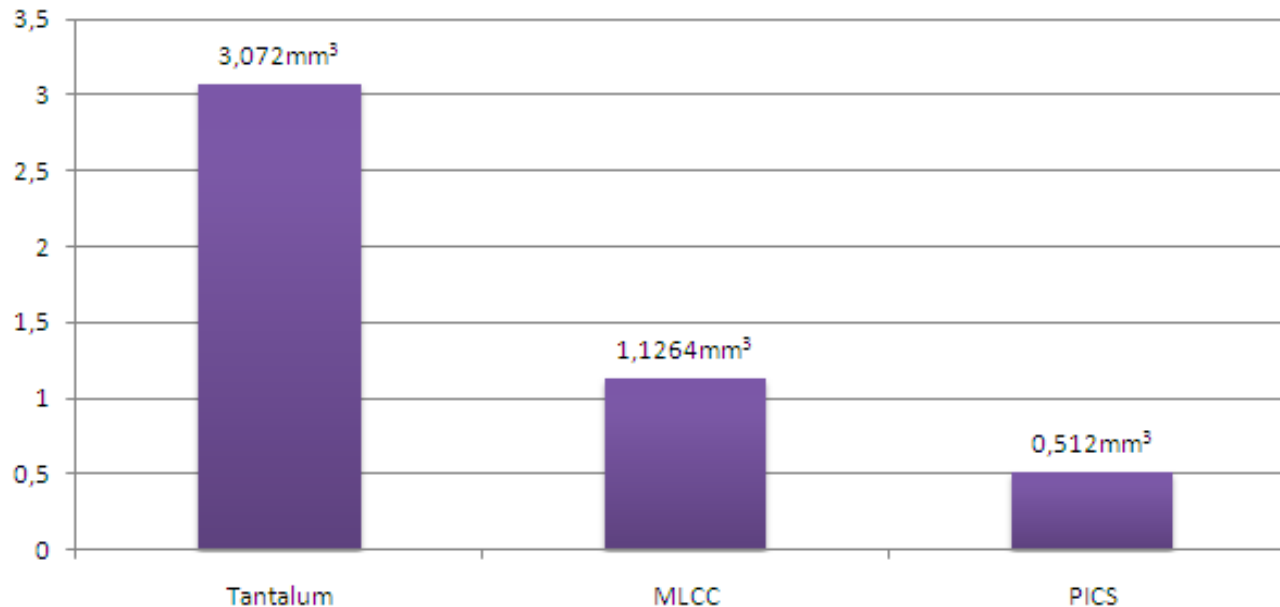


Silicon passive as **Low profile 1 μ F capacitor** in a SiP **Stand-alone component**

Low Profile Silicon Capacitor (LPSC)

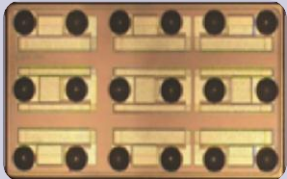


Typical 100nF Capacitor Thickness



Volume comparison of 1206 Case size capacitors

Silicon Capacitors Array



Embedded capacitors

Market: communication

Frequency range: from 1 to 2GHz

Embedded binary capacitor (150 μ m thickness)

Application: decoupling and RF matching

Capacitors array

Market Application: Medical

Frequency range: 1GHz

Components: decoupling capacitors.

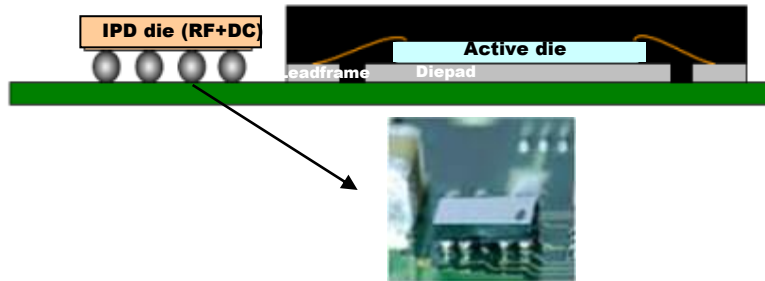
Capacitance matching better than 1.5%

Packaging roadmap: WLP, SiP and interposers

Packaged IPDs

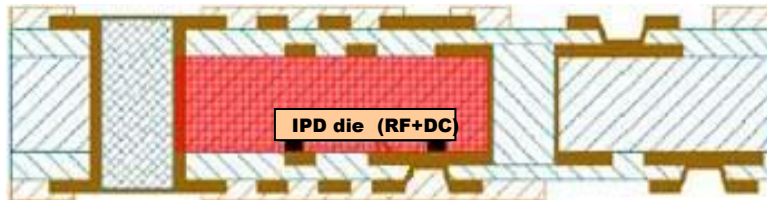
1

Companion
chip on Board



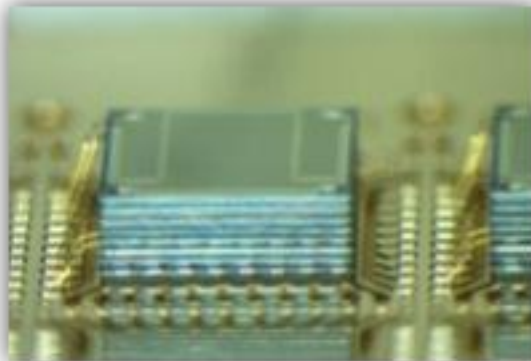
2

Embedded
die in Board



3

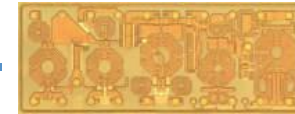
Stacked dies



IPDs and 2/2.5/3D interposers in SiP

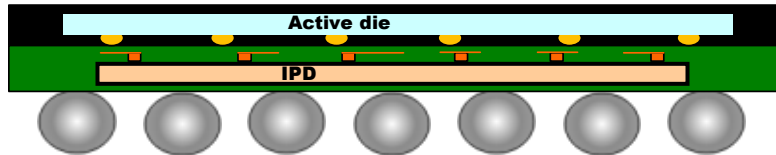
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**Companion
chip in MCM**



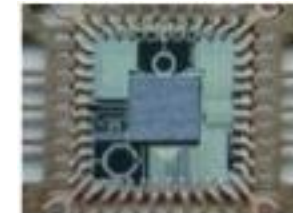
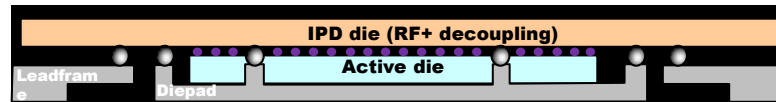
2

**Embedded
die**



3

**SiP
Carrier +DFC**



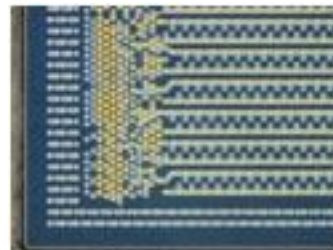
4

**MCM
Carrier +SFC**



5

IPDs and TSVs





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